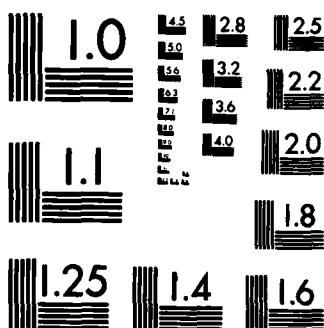


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Final Report No. UWA/DME/TR-85/52

ANALYSIS OF TRANSIENT STRAINS SURROUNDING RUNNING CRACKS
IN METAL AND PLASTIC PLATES

by

A. S. Kobayashi

August 1985

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1. Precis of Significant Accomplishments

The objective of this research program is to investigate experimentally the transient strain and stress distribution in the vicinity of a running crack in engineering materials.

Since the inception of this research project in February 1964, dynamic Moire fringe method and dynamic photoelasticity were used to determine transient strain and stress distributions in fracturing epoxy, magnesium and aluminum plates with central cracks and dynamic fracture toughness and crack arrest stress intensity factors in unstiffened and stiffened Homalite-100 plates. The Homalite-100 specimens consisted of single-edge notch (SEN) plates, with or without central holes subject to uniaxial tension, with or without impact loading, wedge-loaded (WL) rectangular double cantilver beam (DCB) specimens under static load, impact loaded Naval Research Laboratory (NRL) notch bend specimens and modified compact tension (M-CT) specimens. Wedge-loaded (WL) rectangular DCB specimens, NRL notch bend specimens, transverse WL M-CT specimens, and SEN plates, which were machined from thin annealed polycarbonate sheets, were also analyzed. An over-deterministic method has been used to re-evaluate the dynamic crack tip stress field, of the past and recent dynamic photoelastic tests. The results were used to verify a dynamic crack curving criterion, which is valid under combined modes I and II or mode I loading alone and which is based on either the maximum circumferencial stress or minimum strain energy density factor. A dynamic crack branching criterion, which requires a crack branching stress intensity factor as a necessary condition and the crack curving criterion as a sufficient condition, was also developed.

Research efforts for the last year involved the construction of a 2000-lb biaxial testing machine which was then used to conduct dynamic photoelastic analyses of dynamic crack curving and crack branching in Homalite-100 plates under biaxial tensile loading. Data generated was used to further verify or disprove the dynamic crack curving and branching criteria described above. Simultaneously a single-flash, white-light moire interferometric system, which utilizes a grating of 600 rulings/mm, is being developed for studying dynamic crack propagation, arrest and curving in ductile aluminum.

2. All ONR Technical Reports and Other Related Publications

Forty-nine ONR technical reports and sixty-five papers were prepared from the results obtained in the twenty years of investigation. The latter includes;

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